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ON ITS WAY

A torpedo being launched from one of the tubes of a U. S. destroyer.

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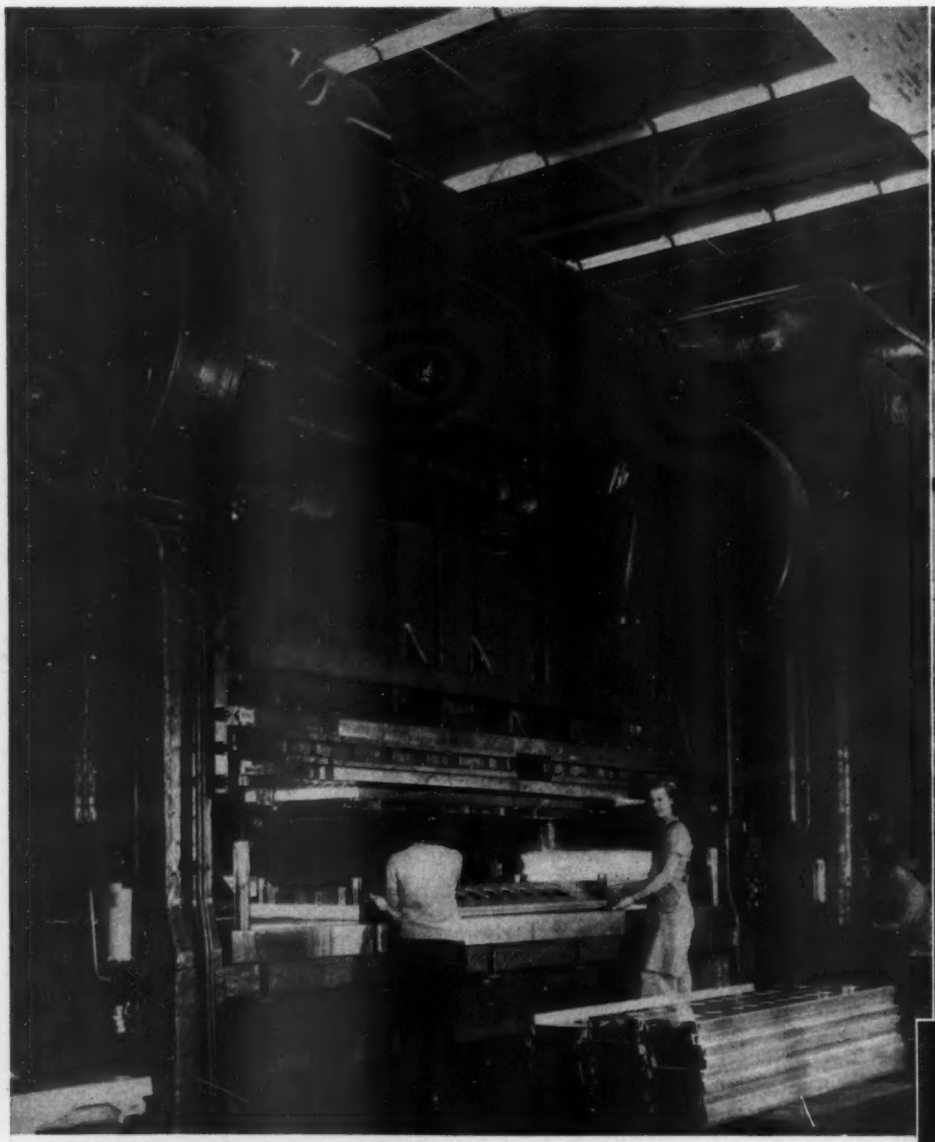


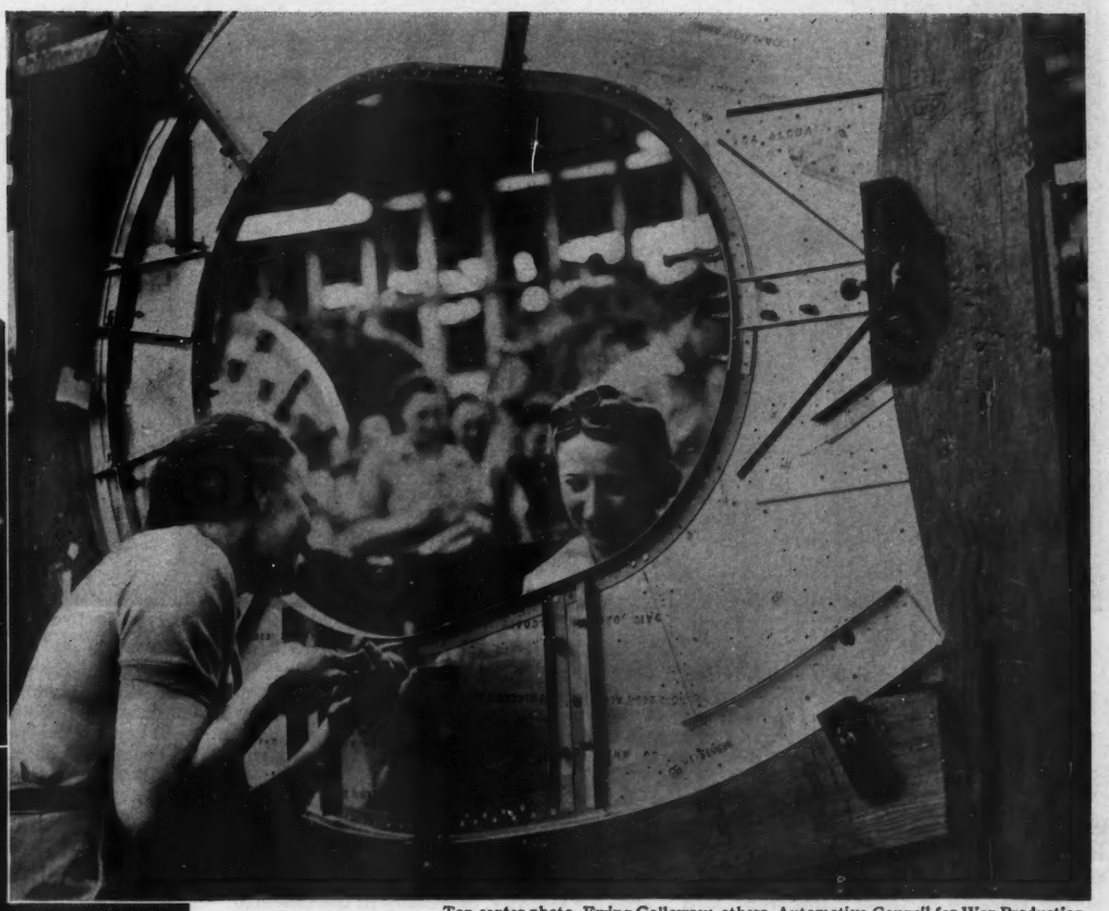
THE hand that rocks the cradle now also performs many tasks in industry that have been traditionally reserved for men. The war has done more in a few months to upset preconceived notions of division of work among the sexes than any social movement could accomplish in decades. Under the stress of the emergency, women have progressively extended their sphere of usefulness inside factory walls, and the movement is still far from its peak. At the outset of hostilities there was such a great surplus of male labor that no thought was entertained of competition between men and women for the so-called overall type of jobs. Now the tendency is to replace men with women wherever the latter can come close to attaining the same degree of proficiency. It is but one phase of the vast readjustment of the human race that has been brought about by the incidence of an international conflict of unprecedented proportions.

This trend to increase the scope of feminine productiveness has manifested itself in the various warring nations in the order of their participation in the struggle. With characteristic thoroughness, Germany figured out long before she launched her first attack that a great many of her male workers would have to be released for military service, and began replacing them with women. The same conclusion was enforced upon Great Britain and Russia as they got deeper into the war, and now we in the United States are likewise beginning to appreciate the full import of this transformation in the ranks of labor.

In Germany, the army of women in war industries is reported to be 15,000,000, and this must be a large proportion of the total working force. Similar statistics for Russia and Great Britain are lacking, but it is officially stated that more than 4,000,000 British women have registered for such jobs under the system of conscription that has been set up. This is in addition to the 1,000,000 that have registered for war services of various kinds. In excess of 1,000,000 have already been drafted for industrial work, and about 50,000 are being interviewed and made available for

Women In Industry

C. H. Vivian



Top-center photo, Ewing Galloway; others, Automotive Council for War Production.

DOING THEIR BIT

Women factory workers in the United States are doing extremely varied work, including just about every kind of job that does not call for great physical strength. The worker at the top-center is operating a forming press that makes parts for radio receivers. Above, Mrs. Betty Steinacher and Mrs. Emily Toth are riveting a fuselage section of a bomber in a plant of the Hudson Motor Company. Both of the employees pictured worked in the factory before it was converted from automobile to war production. Women excel in handling small parts such as the ball-bearing races seen at the lower left, but even large machines are being entrusted to them, as shown at the extreme left. Here the Misses Josephine Badalamenti and Hilda Kalte are operating a huge press in the Ford Willow Run bomber plant.

the purpose each week. Over-all figures cannot be given, because the number that had voluntarily entered industry before conscription became operative is not announced.

In the United States there were engaged in war production at the turn of the year approximately 4,000,000 women, according to Paul V. McNutt, chairman of the War Manpower Commission. This was a gain of 800,000 in a little more than three months and represented about 23 per cent of the total war labor force of 17,500,000. By the end of 1943, Mr. McNutt predicts, there will be 6,000,000 women workers, and they will make up nearly 30 per cent of the estimated total. "Women," he says, "will play an even greater role, numerically and proportionately, in the essential civilian trades and services which are necessary to maintain the wartime economy. Here they are replacing men called to the armed services and those needed in the heaviest industrial jobs which women do not have the strength to fill. Women are already being used in such traditionally male jobs as gas-station attendants, taxicab and delivery-truck drivers, butch-

Automotive Council for War Production Photo.

ASSEMBLING DELICATE INSTRUMENTS

Feminine hands are well adapted for the delicate task of building directional indicators, in which they are engaged in this view of one of the assembly lines in a plant of the Ternstedt Manufacturing Company, a division of the Fisher Body Works of the General Motors Company. These instruments are adjusted so nicely that an invisible speck of foreign matter will throw them out of control. Consequently, all work on them is done in rooms supplied with washed air and kept under pressure. The employees wear smocks made of lint-free material.

ers, mail carriers, and even construction laborers. This trend will increase until by the end of the year as many as 45 per cent of the workers in these home-front jobs will be women."

In direct war industries, the story is much the same. Between 1940 and September, 1942, the percentage of women engaged in the production of aircraft rose from less than 5 to 17 per cent. By the end of 1943 it is expected that more women than men will be building airplanes. As of last September, the percentages of female workers in various other key war industries were: communications equipment, 48 per cent; electrical machinery, 36 per cent; small-arms ammunition, 35 per cent; scientific and technical instruments, 34 per cent; rubber products, 33 per cent; electrical equipment, 27 per cent; chemicals and allied industries, 23 per cent; firearms, 22 per cent. In the heavy industries, the proportions were lower, but impressive. Women made up 19 per cent of the ordnance workers, 9 per cent of those employed in the manufacture of guns of more than 60 calibre, 7 per cent of the labor force in tank factories, and 9 per cent of the total in the iron and steel industry itself. So far, shipbuilding has felt the inroads of women least, but even there three out of every 100 workers are feminine, and the rate of influx is growing steadily, especially in the Government navy yards.

Although we have heretofore thought of these fields as being exclusively male territory, this is not strictly true, for in certain industries, notably in the apparel and fabric trades and in the manufacture of tobacco, textiles, and leather and leather products, the percentage of female workers has been large for many years. During World War I, women entered other lines, and of the total labor force of 9,000,000 that was ultimately engaged in essential war industries 2,000,000 were women. Most of them have been replaced by men in the intervening years, but some of them have stayed on. The 1940 census discloses that 11,000,000 women were then employed and that they were to be found in almost every classification of labor. The only occupations they were not filling were those of railroad conductor, baggage handler, and locomotive engineer and fireman. They were working in blast furnaces and steel mills, in sawmills, and as bartenders. Thirteen were listed as blasters and powdermen. There were 51 women aviators, and more than 100,000 were classified as bakers, electricians, machinists, and blacksmiths.

What about woman's current role in industry? What kinds of industrial work can they do best? How does the quality of their work compare with that of men? Are they as steady and reliable as men? Do they require special handling, and do they ask special favors? These and many other questions are being asked. Some of them can be answered specifically; others only in general terms. Many plant executives who are now dealing with women shop workers for the first time shy away from replying to them at all. They say they would like to know the answers themselves. The best answers to most of these queries cannot be obtained from any one plant, but only through the examination of mass data based on wide experience.

Generally speaking, women have certain limitations that prevent them from filling every type of job. On an average, a woman has only a little more than half the strength (expressed in pulling power) of a man. She is more susceptible than the male to some industrial poisons (such as lead, arsenic, silica dust, etc.) and cannot

NATTY UNIFORMS

Misses Dorothy Chenoweth, Katherine Mrazek, and Doris Fisher, plant employees of the Monsanto Chemical Company of St. Louis, Mo., demonstrate the new 2-piece slack suits and cap which have been adopted there. The ensemble was designed by Mrs. Loretta Moushey, assistant director of industrial relations at Monsanto.

resist heat as well as he can. These facts determine to some extent the kind of work to which she can be assigned. Moreover, it must not be forgotten that the primary function of a woman is to be a wife, mother, and housekeeper, and that she should not be called upon to do jobs that will affect her fulfillment of these roles.

The Germans recognize this viewpoint and are careful not to permit women to perform labor that is likely to undermine their health and vitality. For example, they limit the permissible lifting load to 32 pounds. In our own country, the limitation is more flexibly expressed, the U. S. Women's Bureau declaring that the maximum should be 35 per cent of the worker's weight. Even then it is pointed out that there are individual exceptions to the rule, it being cited that in one foundry women regularly lift castings weighing up to 60 pounds from the floor to a bench with no apparent injury to themselves. The general premise is, however, that lifting should be reduced to a minimum if muscular strain is to be avoided and maximum production attained. This does not mean that women must be barred from jobs involving lifting that is generally considered beyond their capacity. Where the operation is incidental to the principal work performed, mechanical aids often can be arranged to do it for them, or one or two men can be used for that purpose. Where lifting means shoveling, or handling material in containers, loads can be lightened by reducing the size of the shovel or container.

Experience indicates that women excel in certain work of which there is an abundance in war industries. Some supervisors go so far as to say that they are better than men in some instances, although the average foreman who has been accustomed to handling only men usually is very chary about making such statements. He is skeptical concerning women workers when they come into the shop, and they have to earn his praise the hard way before he will bestow it. The kinds of jobs for which women are apparently best suited are:

1—Work that requires care, constant alertness, good eyesight, and the use of light instruments such as gauges. Typical jobs are machining metal parts, inspecting castings, making analyses, and testing light equipment such as electrical appliances.

2—Operations that call for dexterity and speed but permit the worker to set her own gait and to sit down. Typical jobs are laying out work for machine operators, running machines to finish small and irregular parts, assembling delicate instruments or machines, loading shells, and filling powder bags.

3—Work that involves considerable skill but does not require great strength. Typical jobs are working on small parts and operating lathes, drill presses or milling machines, and grinding or polishing machines.

The foregoing are generalizations, and outline the broad classifications for which the average woman is best qualified. In addition, women will occasionally do good work where it is little expected of them. In England they are being successfully employed for such divergent tasks as truck driving and maintenance, handling cranes, railway-shed work, boiler work, fixture work, general and specialized assembling, aircraft detail fitting, many forms of electrical work, and all kinds of welding. One railroad reports that they have proved to be excellent operators of forging hammers. A survey of Canadian war plants shows that 565 of 623 operations studied could be performed by women. Regardless of the country concerned, supervisors agree that best results are obtained by men and women working side by side and by allotting to the female contingent the particular jobs for which they exhibit the most aptitude and possess sufficient strength.

To the question of whether women a

BACK TO SCHOOL

Most plants put women through a training period before putting them to work, and many conduct schools for new employees. Just above are shown General Electric workers who volunteered to attend classes that were arranged for them at a local high school. They study mathematics, blueprint reading, and the use of measuring instruments, gauges, microscopes, etc. The girls pictured at the upper left are receiving instruction in chemistry to fit them for jobs in a synthetic-rubber plant that will be operated by Koppers United Company in the Pittsburgh area. The Studebaker Corporation is conducting a school for women automobile mechanics that are to help its dealers set up similar courses for women who are to replace mechanics entering the armed services. At the upper right the class is listening to a lecture on carburetion.

as reliable as men, there seems to be more than one answer. As a group, women are absent oftener than men, although this is not true for all ages. Older women, from 30 to 55, are more stable emotionally than younger ones, assume responsibility more readily, and are more apt to stay on the job. They also can do heavier work because they are huskier. On the other hand, those under 30 are more energetic, learn quicker, and work faster. Absenteeism averages about 8 per cent among women as against around 3 per cent for men. The underlying reasons are that there is a higher rate of illness among women, that their greater domestic responsibilities keep them home oftener, and that they take more time off for shopping or recreation. As regards the latter, it should be borne in mind that a considerable number of women work only to earn extra money.

Available statistics indicate that industrial accidents befall women with no more frequency than they do men. Women are hurt oftener by falling than from any other cause. As might be expected, there is a higher injury rate among female than among male machine operators. On the other hand, the former handle objects more surely, although this may be because they lift lighter loads.

Many women are unsuited for industrial work because they have a natural fear of machinery. Others won't remain on a job that gives them grimy hands. Some employers show them the dirtiest aspect of the work for which they are applying and note their reactions before going on with the interview. Incidentally, it is generally conceded by personnel supervisors that interviews with women applicants should be more extended than those with men. Most of them have had no previous experience in the work open to them, and the determination of what they are best qualified to do must be based on a knowledge of their hobbies, recreation, family background, and home or school activities. Many employers prefer to hire women who have had no previous experience, stating that they can be trained easier because they do not have to "unlearn" any wrong methods that they may have acquired.

Investigations by the War Manpower Commission indicate that the training of women for war work "does not call for new, different, or additional operational instructions." On the contrary, reports the Training Within Industry Division, "A manual that is adequate to inform and guide men will suffice for women, and in many instances it has been demonstrated that women are quicker on the uptake and in manual dexterity than men. New to the industrial world and eager to do their full share in the nation's emergency, women bring to war-production work an enthusiasm and alertness that make them particularly responsive to training procedure and also invariably amenable to estab-

lished shop practices and methods. Moreover, they do not as a group ask for favors or special consideration because of their sex."

It is pretty generally conceded that there are special problems in supervising women, and that greater attention must be paid to them than to men. Women are quicker to detect and to resent evidence of favoritism, and foremen have learned that they must scrupulously avoid any display of partiality that might engender jealousies. Women are naturally less familiar with machinery than are men, and additional time must consequently be spent in breaking them in. Unmarried women, as a rule, look upon their employment as temporary, hoping to leave it some day for marriage. Accordingly, they lack the stimulus of ambition that is commonly found among men and are not so concerned as they are in working for promotions. One favorable aspect of the fact that they consider their jobs only temporary is that they will accept monotonous work more willingly than will men.

Aside from the necessity of complying with Federal and state laws regarding hours of employment, the maximum work day and work week for women should be less than for men because they reach the "fatigue" point quicker. Most employers have found that when women are on the job longer than 40 to 48 hours a week, depending upon the type of work, the waste, accident, and absenteeism rates rise perceptibly. In Great Britain, part-time employment of women has proved successful. This plan gives them ample time for home duties, shopping, and social activities, reduces lost time and illness, and leads to greater efficiency on the job. Best results have been obtained with a work week of two or three full days rather than shorter hours daily the entire week.

Although many industrial plants are now having their first experience with women workers, others have "been through the mill" for many years, and the observations of one in the latter group should be of interest. Writing in the *Executives Service Bulletin* of the Metropolitan Life Insurance Company, Dr. Charles Francis Long, medical director of Bayuk Cigars, Inc., Philadelphia, Pa., touches upon many phases of the subject. His firm's factory personnel is 85 per cent female. "It is essential, and I have chosen the word from experience," says Doctor Long, "that a woman have an adequate physical examination before she is placed in a job. The first prerequisite of a good preëmployment examination is the job specification, so that the physician can know in complete detail the kind of position the applicant is to fill. He cannot visualize this from a distant office chair; he must be invited to the factory, watch the work process in action, and see for himself exactly what is required. The physical examination will then be a real effort at proper job placement."

Doctor Long has the following to say concerning safety precautions and sensible dress: "A machine adequately guarded so that it is safe for men is just as safe for women, but management must see to it that women's apparel at the machine is as safe as that of most working men. A very important consideration in factory work is that the female of the human species delights in adorning herself. Be that as it may, management cannot, for obvious reasons, allow long-sleeved blouses with frills down the front. Also, the hair must be either bobbed or worn close to the head for the very good reason that a machine is a more efficient scalping device than an Indian. Next, we turn to the curious devices that some women walk in, which no orthopedist or anyone else in his right mind would describe as working shoes for factory use. Our safety campaign really got a start when one of our employees coming downstairs lost both the heels from her shoes and sat down so violently that her coccyx was broken. Those shoes were paraded on a truck through the plant, together with a pair of proper work shoes, and from that time to this day low-heeled oxfords with straps or laces over the instep have been the only working shoes allowed for women—and we haven't had a shoe accident since that rule was made.

"Thinking further of the decorative desires of women as related to safety, we must consider jewelry. If anyone has seen a lacerated finger further mangled by the cutting edge of a ring worn at the time of the accident, there will be no difficulty in understanding what I have in mind. We do not allow jewelry of any kind to be worn at work, and that includes wrist watches and wedding rings.

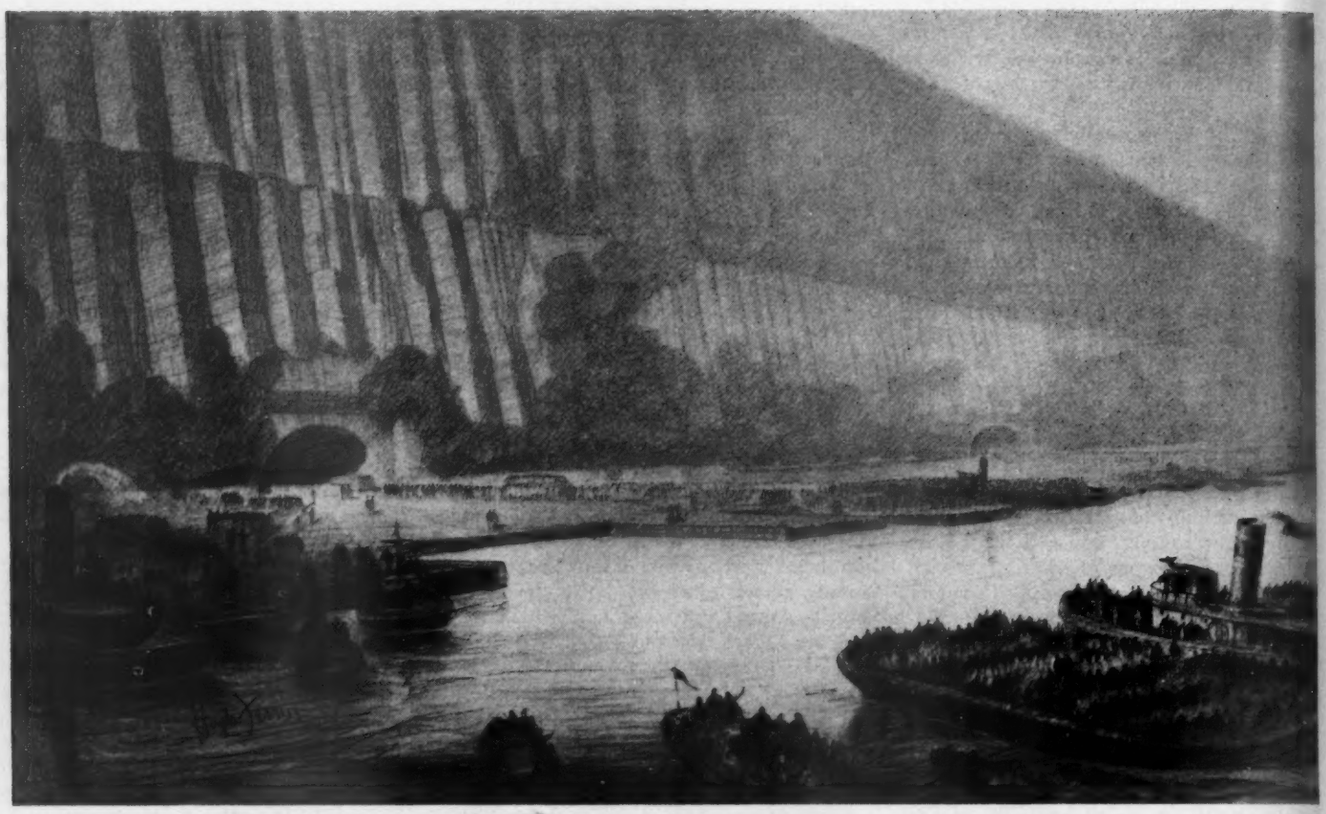
"Another important safety factor is obesity, a disease more common to women than to men. We have established an arbitrary rule that 200 pounds is our limit. This is based on the obvious fact that a thick body is a more effective cork in a passageway than a thin one. We once had a near panic when an air-conditioning duct fell. The stout girls who moved more slowly were worse bruised and hurt than the girls on whom the duct fell. The heavy ones got trampled by those who were more active.

"I have often been asked whether machine work makes women nervous. My experience has been just the contrary. The routine of the machine seems particularly pleasing to them. They are not fatigued by it, and I think that they enjoy the companionship of working with women. It has been my observation that nervousness in women who operate machines has only two basic causes—disease or domestic difficulty. When a woman is brought to the dispensary crying or shaking with 'nerves,' she is examined; and if no physical illness can be discovered, my next question is, 'What's wrong at home?' The answers will run the gamut from teething babies all the way through ungrateful husbands to troubles with boy friends, or perhaps impossible 'inlaws.' But the foreman on the job does not make them nervous."

Compressed Air Institute Photo.

CUTTING WORKER FATIGUE

This employee of an aviation plant is using a compressed-air drill to put a diagonal chamfer on an aircraft-engine part. Air-operated tools, special air chucks, expanding arbors, and other similar devices are eliminating hand and arm motions in machine shops and reducing worker fatigue while increasing production.



Bomb Shelters in Hudson Palisades Proposed

THE accompanying pictures show how the Palisades, bordering the Hudson River directly across from New York City, could be utilized for bomb shelters under a plan sponsored by George J. Atwell, prominent New York contractor. Mr. Atwell has laid his suggestion before President Roosevelt, Gov. Charles Edison of New Jersey, and various military and civilian-protection authorities, all of whom have expressed interest in its possibilities. The scheme embodies measures similar to those taken at Chungking, Dover, the Island of Malta, and Gibraltar, where underground galleries offer the citizenry and even some essential industries refuge from bombings.

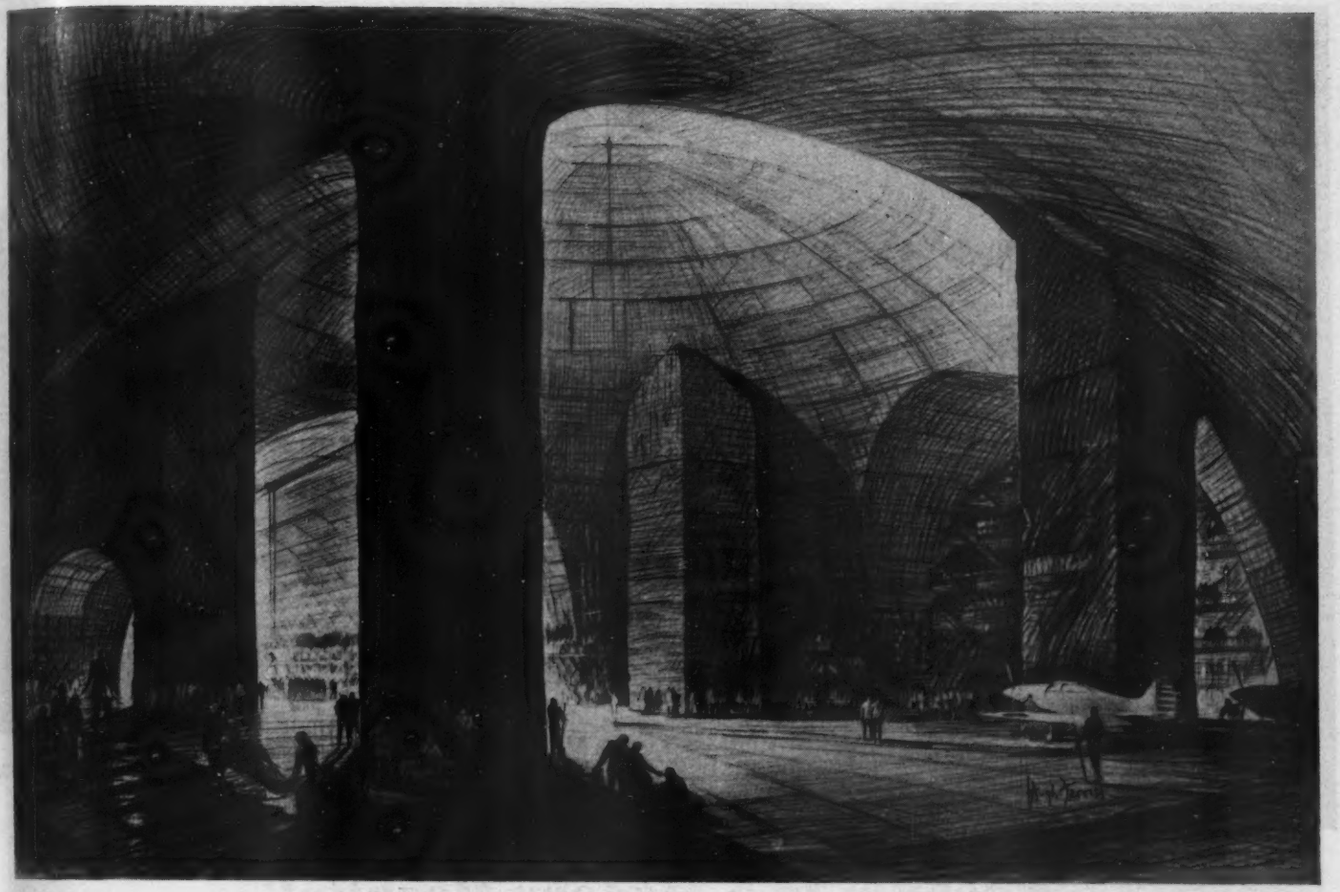
The topography and geological features of the Palisades are highly favorable to the plan. The cliffs rise sheer from the west side of the river to a height of 200 feet and more, extend for several miles along the stream, and have a horizontal thickness of approximately 1½ miles throughout that section. They are composed of doleritic rocks which were intruded from subterranean lava reservoirs and spread out laterally between the horizontal beds of sedimentary deposits that formed the surficial covering. During the intervening centuries—geologists estimate the age of the Palisades at 150,000,000 years—the softer sedimentaries were worn away, exposing the igneous rocks. Along their eastern edge a deep gorge was cut by the Hudson River, and this was followed by a period of general subsidence, accompanied by filling of the stream bed with silt to its present level.

Mr. Atwell, who says the plan was suggested to him by John C. Evans, chief engineer of the Port of New York Authority, proposes to drive a tunnel, 200 feet wide and 100 feet high, through the Palisades at a point just above the high-water level of the river and emerging in the meadows of New Jersey to the westward. Within the depths of the sheltering rock he would enlarge this passageway to provide immense, pillar-supported rooms to serve as airplane hangers, depositories for national art treasures, sites for vital manufacturing plants, and havens during air raids for a large number of the people living in the environs.

All this, Mr. Atwell contends, could be accomplished with equipment and materials that are plentiful. As the rock, which is already penetrated by several transportation tunnels, is self-supporting, no buttressing steel would be required. Drill steel, dynamite, power shovels, and trucks would be the essential equipment needed. From an engineering and construction standpoint, Mr. Atwell declares, the operations would be simple, classing them as run-of-the-mill work such as his firm carried out when it excavated for the foundations of Radio City a quantity of rock weighing more than the towering buildings that now stand on them.

Such an underground safety zone would involve an expenditure of $37,500,000, according to Mr. Atwell's calculations. Realizing that it would probably take considerable time to obtain authorization for a project of this magnitude, he is working on a smaller scheme to cost around $5,000,000, and hopes to get early action on it by the Government. This plan calls for a pilot bore with floor space for from 50 to 75 airplanes and could be completed in six months. The rock removed would be used to build a landing field, 500,000 feet square, along the river.

Both Mr. Atwell and Mr. Evans take a long-range view of this undertaking, pointing out that it would serve the needs not only of the present but also of future wars. Among the peacetime uses, they envision one of the underground rooms as a place of assembly for 200,000 persons. All the rock chambers could be ventilated naturally and would have a favorable year-round temperature.



ARTIST'S CONCEPTIONS OF THE ATWELL SCHEME

To give the public a graphic idea of how his plan would work, Mr. Atwell had these drawings prepared by Hugh Ferriss, one of the architects who formulated the general scheme of the New York World's Fair. One of the refuge rooms hewn out of solid rock is depicted at the top of the page. Below it swarms of fighter planes are shown emerging from tunnels and taking off to combat enemy craft. The sketch on the opposite page indicates how boats and barges could evacuate New York City residents to the haven of safety should that ever become necessary.

THE EASTON HOSP

Vacuum in a Modern Hospital*

Julius Naab†

AIR AT pressures above as well as below that of the atmosphere at sea level—14.7 pounds per square inch—has become such a vital part of our everyday life that it is only natural that the medical profession should make use of it. For many years dentists have applied vacuum to rid the mouth of saliva while working on a patient's teeth, thus keeping the mouth dry and, what is more important, the cavity to be filled.

One of the messiest operations is the simple tonsilectomy, which ordinarily requires the use of many sponges to absorb the blood and saliva. Being inside the throat there is not much space in which to work, and it is consequently difficult to keep the passage clean and free of liquid while the tonsils are being removed. The first attempt to use vacuum for this purpose was successful, and today most surgeons draw the liquid out of the throat with a small vacuum pump. This unit is capable of pulling about 20 inches of vacuum and has a second cylinder that compresses air to approximately 1½ inches of mercury, positive pressure, to administer ether to the patient prior to the operation. However, the machine is very inefficient and is equipped with a standard motor that introduces the hazard of explosion from sparking in the presence of ether.

In 1933 Dr. C. G. Harmon, who was chief nose and throat surgeon at the Easton Hospital, Easton, Pa., prevailed upon the authorities to replace the small unit with a central vacuum system. This is probably the first installation of its kind, and opened a new field for small vacuum pumps. A standard garage-type, motor-driven compressor with receiver, piped to intake instead of discharge so as to serve as a vacuum pump, was installed in the basement of the hospital, and a pipe line was run from it to the minor operating room on the fourth floor. The unit is arranged for automatic start-and-stop control through an electric pressure switch that is set to cut it out at 20 inches of suction and in at 15 inches.

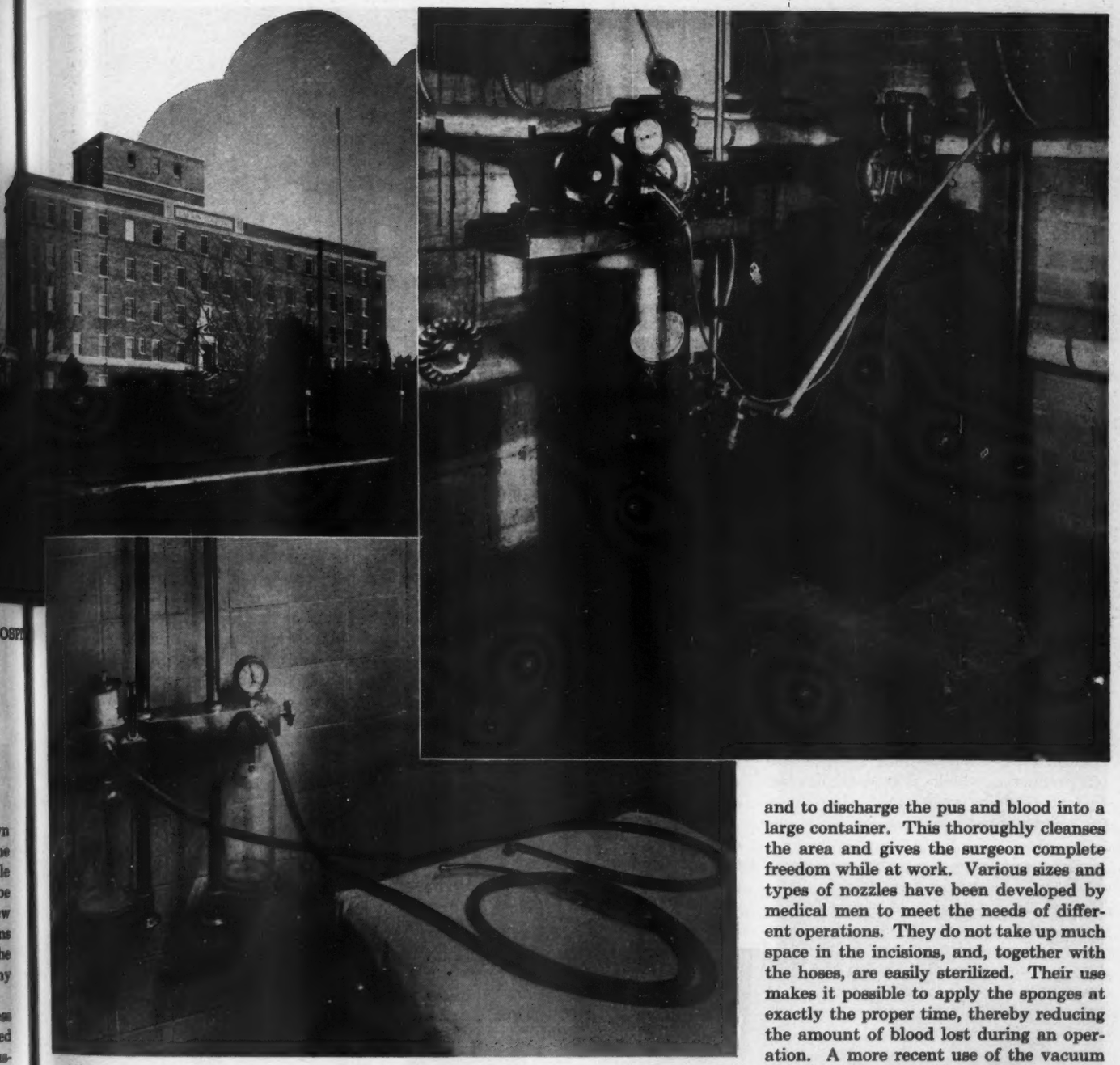
The application of a vacuum pump for this service entailed the designing of a manifold with two receptacles—one for the liquid taken from the mouth and the other for the ether which is given under pressure and keeps the patient anesthetized during the operation. Into this manifold was built a valve to control the vacuum which, necessarily, varies with the patient and the condition of the throat. The container for the withdrawn liquid holds about 1 quart, and with the valve and a quick release it is a simple matter to empty the receptacle and be ready for another tonsilectomy in a few minutes. Ordinarily, two such operations can be performed in an hour, but with the vacuum plant it is possible to do as many as thirteen in two hours.

Without the aid of vacuum, an endless supply of sponges were used and dropped on the patient's protective covering, causing staining and calling for frequent replacements of sheets and other bedding. These sponges are squares of gauze rolled into a ball and are usually made at the hospital by the nurses on duty in the operating room. They serve to absorb liquids such as pus and blood and also to apply pressure to stop the flow of blood. Where operating rooms are in continual use, large quantities of them are required, and the making of them takes so much time that additional nurses are needed for that work.

To obtain the necessary pressure to administer the ether, air from the boiler-house compressor is piped to the manifold in the operating room and reduced by means of two valves from 100 pounds to 1½ inches of mercury. This is not so simple, because the requisite pressure must be maintained at all times. To guard

*This article has been made available to us for publication by the Compressed Air Institute and was one of the papers submitted in its Compressed-Air-in-Industry contest conducted last year.

†Mechanical Engineer, Compressor Division, Ingersoll-Rand Company, Phillipsburg, N. J.



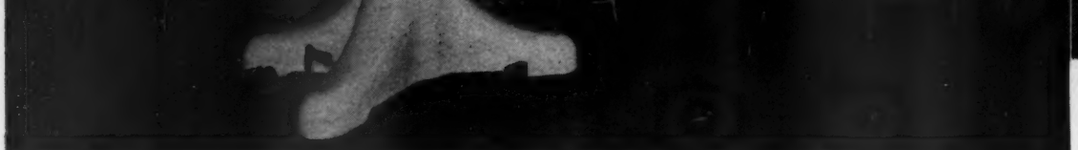
CENTRAL SYSTEM

The mechanical equipment in the basement is shown at the upper right. The unit at the left—a standard garage-type compressor piped to serve as a vacuum pump—was originally used by itself. The smaller right-hand machine, also a compressor arranged to pull a vacuum, was added later as a standby. The view just above shows the piping, collection bottles, and tubes in a minor operating room on the fourth floor. The assembly at the left supplies air under pressure from the boiler-house compressor for administering the anesthetic; that on the right is the vacuum system. These services are extended to the main operating room, seen on the opposite page, by hose from wall outlets in the piping system.

against excessive pressure the system is protected by mercury-type safety valves. Reduction is effected in two steps: first from 100 to 25 pounds, and then from 25 pounds to 1½ inches of mercury. During the tonsilectomy, a tube, connected to the ether supply, is inserted in the patient's mouth to keep him anesthetized, and another tube from the vacuum pump is inserted in his throat to suck out the liquid. With a little practice, the technique of withdrawing it without also pulling off the ether is easily mastered.

As soon as the system was installed it was put in use, and all the surgeons found it to be of tremendous help to them. It was therefore only natural that the new drainage method should be applied to other operations. In all abdominal cases, it is now the practice to insert in the incision a special nozzle connected to the vacuum-pump manifold by a long tube and to discharge the pus and blood into a large container. This thoroughly cleanses the area and gives the surgeon complete freedom while at work. Various sizes and types of nozzles have been developed by medical men to meet the needs of different operations. They do not take up much space in the incisions, and, together with the hoses, are easily sterilized. Their use makes it possible to apply the sponges at exactly the proper time, thereby reducing the amount of blood lost during an operation. A more recent use of the vacuum system is that of cleaning intravenous and transfusion tubes by drawing distilled water through them. Heretofore this has been a tedious process.

Surgeons and nurses at the Easton Hospital, as well as the management, are agreed that the vacuum system as installed has definite advantages: The surgeons, because it insures a cleaner incision, more positive removal of liquids, and a much freer working area. The nurses, because it reduces the number of sponges they must make by reason of the fact that fewer have to be applied during an operation. The management, because it saves money by decreasing the number of nurses and sponges required for surgical work, as well as the quantity of linen, and because it offers a much cheaper and better method of cleaning intravenous and transfusion tubes.



Vacuum in a Modern Hospital*

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AIR AT pressures above as well as below that of the atmosphere at sea level—14.7 pounds per square inch—has become such a vital part of our everyday life that it is only natural that the medical profession should make use of it. For many years dentists have applied vacuum to rid the mouth of saliva while working on a patient's teeth, thus keeping the mouth dry and, what is more important, the cavity to be filled.

One of the messiest operations is the simple tonsilectomy, which ordinarily requires the use of many sponges to absorb the blood and saliva. Being inside the throat there is not much space in which to work, and it is consequently difficult to keep the passage clean and free of liquid while the tonsils are being removed. The first attempt to use vacuum for this purpose was successful, and today most surgeons draw the liquid out of the throat with a small vacuum pump. This unit is capable of pulling about 20 inches of vacuum and has a second cylinder that compresses air to approximately 1½ inches of mercury, positive pressure, to administer ether to the patient prior to the operation. However, the machine is very inefficient and is equipped with a standard motor that introduces the hazard of explosion from sparking in the presence of ether.

In 1933 Dr. C. G. Harmon, who was chief nose and throat surgeon at the Easton Hospital, Easton, Pa., prevailed upon the authorities to replace the small unit with a central vacuum system. This is probably the first installation of its kind, and opened a new field for small vacuum pumps. A standard garage-type, motor-driven compressor with receiver, piped to intake instead of discharge so as to serve as a vacuum pump, was installed in the basement of the hospital, and a pipe line was run from it to the minor operating room on the fourth floor. The unit is arranged for automatic start-and-stop control through an electric pressure switch that is set to cut it out at 20 inches of suction and in at 15 inches.

The application of a vacuum pump for this service entailed the designing of a manifold with two receptacles—one for the liquid taken from the mouth and the other for the ether which is given under pressure and keeps the patient anesthetized during the operation. Into this manifold was built a valve to control the vacuum which, necessarily, varies with the patient and the condition of the throat. The container for the withdrawn liquid holds about 1 quart, and with the valve and a quick release it is a simple matter to empty the receptacle and be ready for another tonsilectomy in a few minutes. Ordinarily, two such operations can be performed in an hour, but with the vacuum plant it is possible to do as many as thirteen in two hours.

Without the aid of vacuum, an endless supply of sponges were used and dropped on the patient's protective covering, causing staining and calling for frequent replacements of sheets and other bedding. These sponges are squares of gauze rolled into a ball and are usually made at the hospital by the nurses on duty in the operating room. They serve to absorb liquids such as pus and blood and also to apply pressure to stop the flow of blood. Where operating rooms are in continual use, large quantities of them are required, and the making of them takes so much time that additional nurses are needed for that work.

To obtain the necessary pressure to administer the ether, air from the boiler-house compressor is piped to the manifold in the operating room and reduced by means of two valves from 100 pounds to 1½ inches of mercury. This is not so simple, because the requisite pressure must be maintained at all times. To guard

*This article has been made available to us for publication by the Compressed Air Institute and was one of the papers submitted in its Compressed-Air-in-Industry contest conducted last year.

†Mechanical Engineer, Compressor Division, Ingersoll-Rand Company, Phillipsburg, N. J.

Gone with the Wind

Charles W. Gibbs

IN THE course of a service call, the writer inspected the compressed-air system of an industrial plant, checking particularly for leakage in air lines. The system was found to be reasonably well

tain in the system. Repeated tests have shown that in the case of a pneumatic tool a 5-pound drop in pressure will cut down its output 10 per cent and more. It is clear, then, that a reduction in air

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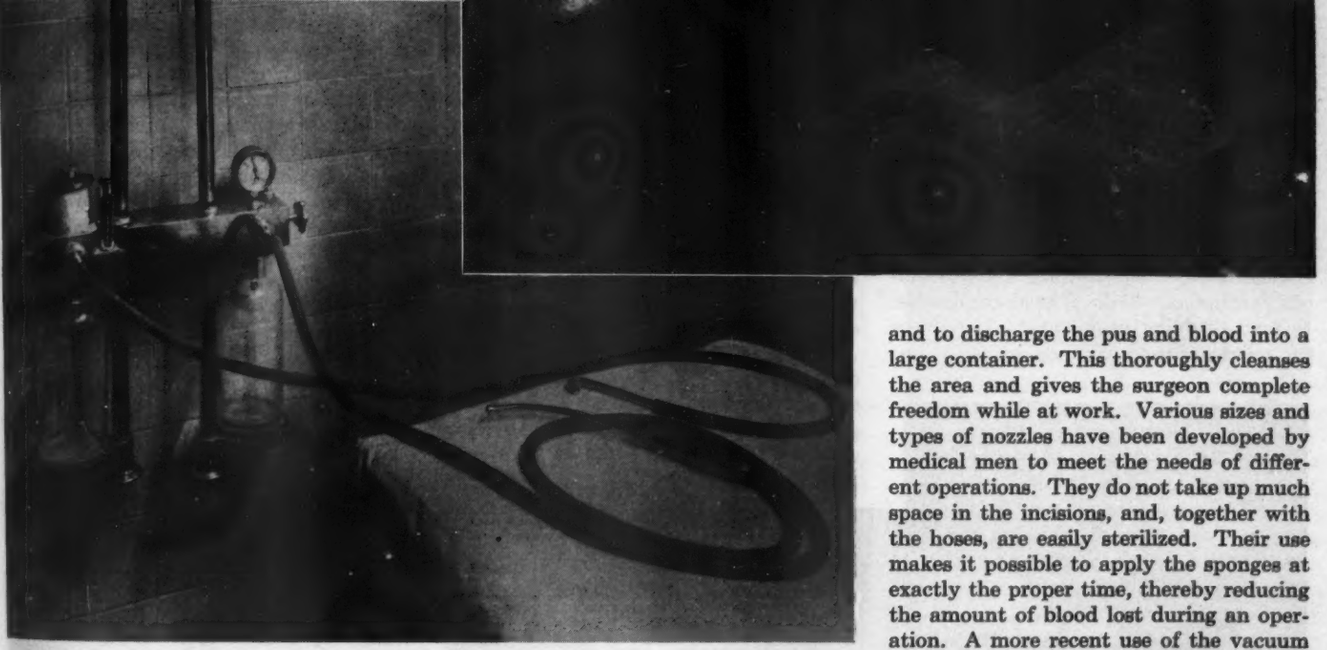


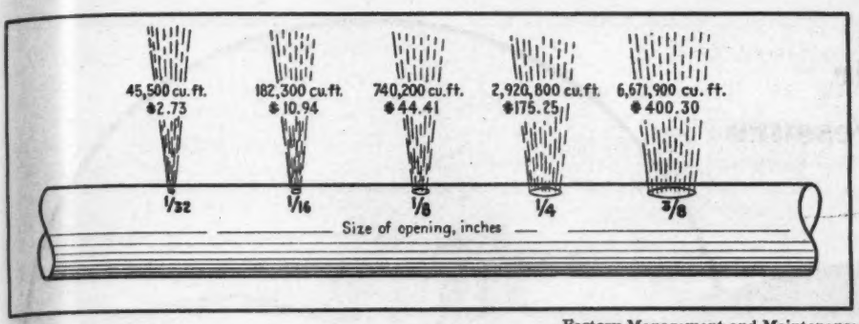
CENTRAL SYSTEM

The mechanical equipment in the basement is shown at the upper right. The unit at the left—a standard garage-type compressor piped to serve as a vacuum pump—was originally used by itself. The smaller right-hand machine, also a compressor arranged to pull a vacuum, was added later as a standby. The view just above shows the piping, collection bottles, and tubes in a minor operating room on the fourth floor. The assembly at the left supplies air under pressure from the boiler-house compressor for administering the anesthetic; that on the right is the vacuum system. These services are extended to the main operating room, seen on the opposite page, by hose from wall outlets in the piping system.

against excessive pressure the system is protected by mercury-type safety valves. Reduction is effected in two steps: first from 100 to 25 pounds, and then from 25 pounds to 1½ inches of mercury. During the tonsilectomy, a tube, connected to the ether supply, is inserted in the patient's mouth to keep him anesthetized, and another tube from the vacuum pump is inserted in his throat to suck out the liquid. With a little practice, the technique of withdrawing it without also pulling off the ether is easily mastered.

As soon as the system was installed it was put in use, and all the surgeons found it to be of tremendous help to them. It was therefore only natural that the new drainage method should be applied to other operations. In all abdominal cases, it is now the practice to insert in the incision a special nozzle connected to the vacuum-pump manifold by a long tube and to discharge the pus and blood into a large container. This thoroughly cleanses the area and gives the surgeon complete freedom while at work. Various sizes and types of nozzles have been developed by medical men to meet the needs of different operations. They do not take up much space in the incisions, and, together with the hoses, are easily sterilized. Their use makes it possible to apply the sponges at exactly the proper time, thereby reducing the amount of blood lost during an operation. A more recent use of the vacuum system is that of cleaning intravenous and transfusion tubes by drawing distilled water through them. Heretofore this has been a tedious process.

Surgeons and nurses at the Easton Hospital, as well as the management, are agreed that the vacuum system as installed has definite advantages: The surgeons, because it insures a cleaner incision, more positive removal of liquids, and a much freer working area. The nurses, because it reduces the number of sponges they must make by reason of the fact that fewer have to be applied during an operation. The management, because it saves money by decreasing the number of nurses and sponges required for surgical work, as well as the quantity of linen, and because it offers a much cheaper and better method of cleaning intravenous and transfusion tubes.



Factory Management and Maintenance

WHAT AIR LEAKS COST

Graphic illustration of compressed-air wastage per month through leaks of various sizes. Volumes are figured on a basis of 100 pounds pressure and a nozzle coefficient of .65. Values are based on a cost of six cents per 1,000 cubic feet.

Valves in air systems are usually placed so that branch lines can be shut off when not required, but all too often they remain open 24 hours a day even though compressed air may be used for only a few hours in that interval. Many instances valve leakage mounts up tremendously under such conditions. Any effort made to train the workers to close branch-line valves when air is not to be used for some time will repay managements well. Tool-operating valves that are maintained as

Gone with the Wind

Charles W. Gibbs

IN THE course of a service call, the writer inspected the compressed-air system of an industrial plant, checking particularly for leakage in air lines. The system was found to be reasonably well installed but old in parts. The trip was a revelation. The number of small leaks—many avoidable or easily eliminated—and the lack of standardized practice in fitting hose, for example, were amazing. A subsequent investigation of other establishments, even by so simple a method as looking closely at photographs, indicated that these conditions are not unusual.

It should be borne in mind that air leakage is wastage; and waste in these critical days, where nothing short of all-out production will do, is gross negligence. Instead of doing useful work, it reduces the pressure that a compressor can maintain in the system. Repeated tests have shown that in the case of a pneumatic tool a 5-pound drop in pressure will cut down its output 10 per cent and more. It is clear, then, that a reduction in air leakage will pay dividends, and with this in view some examples of good and poor practices will be discussed, digressing occasionally to touch on safety and more efficient operation.

First, however, attention is called to the accompanying diagram which gives the air losses for holes of varying sizes. Of course, actual leaks are not round. It is the area that counts, and the air escapes regardless of the shape or size of the opening. The illustration indicates at the same time the worthwhile savings that can be effected if leaks are stopped.

The leaks that could be most readily eliminated in the plant inspected were those around valve stems. Most compressed-air systems have a great many valves. These are usually small, 1 inch or less, and are located near the points where the air is used. A small "blow" through the packing of even 25 per cent of the total number installed wastes a lot of air that has been brought through the mains all the way from the power plant and in that distance has undergone some pressure loss. The wasted air, which represents unnecessary line flow, has increased the pressure drop. This, in addition to the direct air loss, results in a loss in production.

There was also a surprising leakage of air at hose ends—where the hose is attached to spuds or nipples. The condition of the hose clamps indicated a complete lack of standardization in the matter of maintenance practice. Poor hose maintenance, besides wasting air through leakage, is an extremely unsafe policy. Some hose was found that had no clamps at all. Anyone who has seen the free end of a hose whip around when the air is turned on realizes the danger latent in hose joints that are not tight.

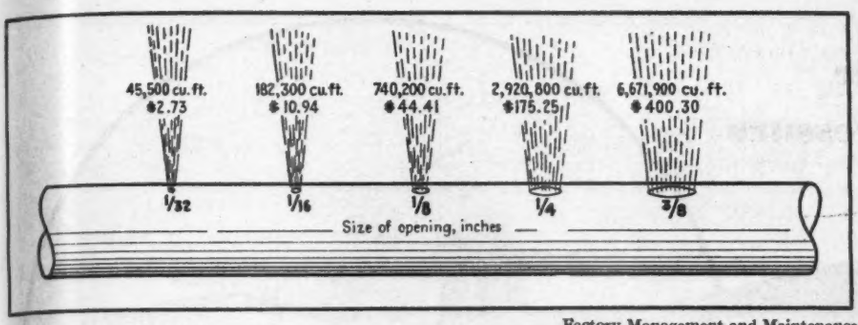
There are two general types of hose clamps: the wire and the bolted type. Both are tight and safe if correctly applied and taken care of. The danger lies in permitting the making of temporary repairs which, in most cases, become permanent hazards and sources of leaks. In the plant visited there was enough hose in use to warrant a "hose-reclamation center" properly equipped to maintain what now comes under the head of critical products. Typical examples of poor practices and makeshifts are shown in accompanying photographs, and possibly a trip around your plant will reveal similar conditions. If so, they should be remedied without delay. It is strange but true that a modern airplane factory was also found to be an air waster.

BLOWGUNS

The right-hand picture shows an approved type of blowgun, with automatic shutoff and 1-hand control. It will close tight, even when dropped. The homemade gun at the left is inconvenient to control, wastes air, and often leaks. Note its bent valve stem.

BRANCH-LINE VALVES

Valves controlling the flow of air to branch lines or hose take-offs should be regularly maintained to prevent leakage. The workman at the right is tightening the packing of a valve. If a branch line is used only for a short while during the day or shift, the valve should be closed at other times (left).



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Valves in air systems are usually placed so that branch lines can be shut off when not required, but all too often they remain open 24 hours a day even though compressed air may be used for only a few hours in that interval. Many instances could be cited where tools and equipment (hoists, for example,) with slightly leaking operating valves were left on the line continuously although they were needed only once or twice a shift, or not at all. Pneumatic tools that were required possibly an hour during a shift were connected and "live" throughout the entire working period. Hose and operating-valve leakage mounts up tremendously under such conditions. Any effort made to train the workers to close branch-line valves when air is not to be used for some time will repay managements well. Tool-operating valves that are maintained as they should be will not leak, but many in the plant under discussion did leak.

In another part of the establishment where air losses were being checked, it was discovered that the homemade type of blowgun, consisting of a globe valve and of a piece of ¼- or ⅛-inch pipe, was especially wasteful, whereas not one of the automatic shutoff guns in service was leaking. The latter type closes tight and may be laid down or dropped without danger of reopening. But an operator may shut the globe valve on his makeshift gun and easily crack the valve open in putting it down. Instances of this kind actually occurred. Furthermore, it takes both hands to open or close the homemade gun, and the blast is not under control. The automatic type is under constant 1-hand control, leaving the other hand free for the work. Moreover, there is no danger of an excessive blast of air blowing loose objects around and thus damaging machinery or imperiling workmen.

The practice of blowing air lines to free them of water or condensate should be avoided because it results in an appreciable loss of air. Instead, lines in which moisture is known to collect should be provided with separators. These need not be elaborate; a piece of pipe, say 4 inches in diameter and 2 feet long, at the end of a feed line may suffice. The inlet should extend through and about 6 inches from the top of the separator, and the outlet to the hose manifold should be at its highest point. The trap must be drained from the bottom as often as is found necessary. The frequency with which this is done will depend to some extent on the weather. If separators and drains are conveniently located, they will be operated, because no workman wants water in the air to slow up his tool.

The air losses discussed are common ones and can be easily remedied. Leak elimination will increase production. Use all the air you need—but don't waste it!

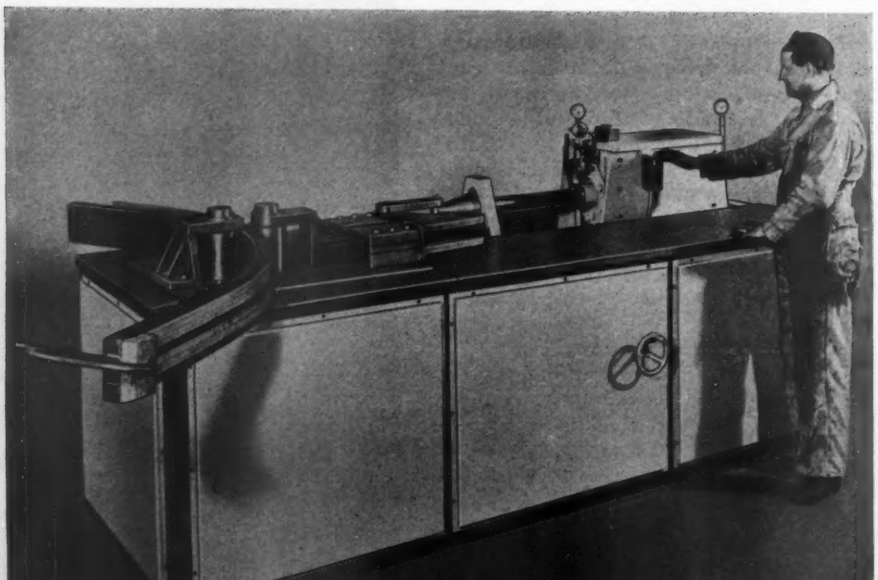
DRAINING SEPARATOR

A simple separator, such as this one, will remove moisture from compressed air and obviate the need of the wasteful blowing of air lines. It is important that moisture traps be drained regularly, and for that reason should be easily accessible.

HOSE CONNECTIONS

The top view shows two types of hose clamps—bolted and wire—correctly applied. The other pictures illustrate makeshift clamps, all of which waste compressed air and also violate safety standards.

Shaping Metal with Air Under Pressure



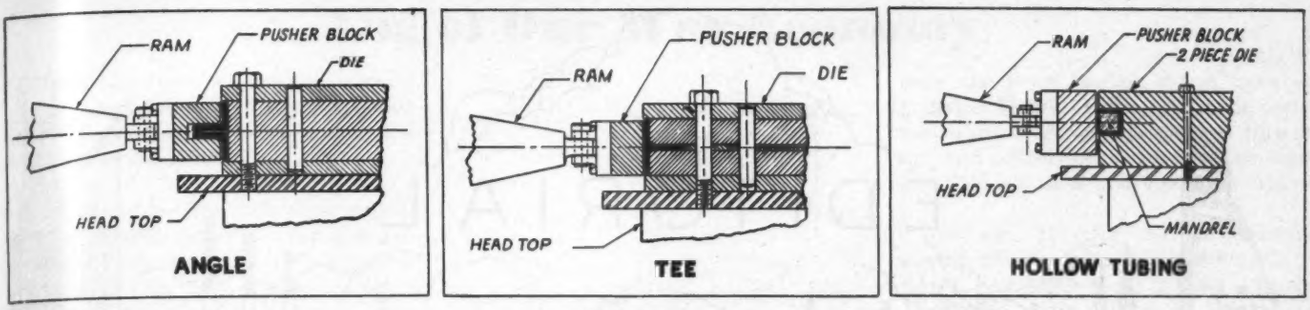
FLOW METAL INTO FORM

At the top is the No. 10 machine with a universal head mounted on a separate semicircular platform that is bolted to the cylinder-assembly table. The legs of the platform are adjustable and are screwed to the floor to assure a steady work bench. The unformed metal is clamped to the die on the rotating head and shaped as it passes the die attached to the air-operated ram, which exerts a pressure of about 5 tons per square inch against the pusher block. The No. 12 for heavy work is at the left and shows the die flow rolls with a typical duralumin section in the process of forming. The unit is equipped with a power booster that increases the pressure applied to the floating roller to a total of 22½ tons.

"FOR want of a nail a shoe was lost ....." and, to paraphrase the opening line of that well-known jingle, for want of a part a plane was delayed. Today, there must be no bottleneck in any department of an industry engaged in vital war work, and the job of keeping everything moving at a pace that will not interfere with production schedules has involved many revolutionary changes in methods and machines. Thousands of parts enter into the manufacture of an airplane, and some of these are made of duralumin and include difficult shapes. To turn them out quickly and with precision, the Southern Engineering Company, Inc., has developed machines that are said to form square and round tubing, and L-, T-, C-, Z-, hat-shaped, and other sections not only of duralumin but also of stainless steel, aluminum, and magnesium alloys.

Instead of bending the metal into shape, as do conventional machines, it is "flowed" into shape by the use of dies to which high pressure is applied by means of a pneumatic cylinder. There are three machines available, the main differences between them being the design of the heads and the methods by which pressure is exerted against the dies. In the No. 10, which is suitable for most requirements, one die is attached to a motor-driven head, and the other, which also serves as a pusher block, to an air-operated ram. The metal to be formed is clamped to the die on the head and shaped as it moves past the pusher block. In the case of the No. 12, which is for extra-heavy work, the metal is clamped to one end of the dies and, together with them, is passed between rolls —a pressure or floating roller and a power-driven roller. With the aid of a booster, using air at 100 pounds line pressure, a total of 22½ tons per square inch is exerted against the floating roll through an interposed wiper block.

Of the different types of heads available, the No. 1, or circular head, is best adapted for symmetrical shapes with no straight



FORMING DIES AND METAL SECTIONS

From left to right, these cross-sectional views show dies used to form parts with legs on the outside of the bend; T's, L's, or parts with the legs extending on the inside; and square tubing. These are typical of the work done on the No. 10 machine. C-, Z-, hat-shaped and similar sections are formed on the No. 12. In the case of round or square tubing—hollow extrusions—or parts with cavities that the dies cannot fill, it is necessary to use either a mandrel or some form of filler such as low-melting-point metal, micarta, or leather compounds.

sections. The No. 2, or universal head, forms small and large radii plus straight sections in a single operation; the No. 3, or straight head, serves principally to make long, slow sweeps and slow reverse curves; and the No. 5, which has one straight side and a symmetrical radius on the other, is the most adaptable of the four. With No. 1, 3, or 5, and with air at 100 pounds, the ram exerts a pressure of about 5 tons against the pusher block.

The No. 15, the newest machine, features a floating pneumatic-cylinder combined with an adjustable, universal wiper block, quickly attachable die flow rolls, and a pressure booster of 3 to 1 that makes it possible to shape very heavy sections. The 12-inch cylinder has a maximum stroke of 22 inches and is built for a maximum line pressure of 250 pounds per square inch. The cylinder assembly can be changed in both the vertical and the horizontal plane. It is attached to a cast-steel center section that travels forward or backward in machined ways and, by means of a unique counterbalance, is moved up and down a maximum of 8 inches. This unit is known as the Master Forming Machine, and is said to be capable of producing sections of any desired length with compound or reverse curves, small radii, slow sweeps, and changes in plane.

Distribution System for Slushing Oils

FINISHED steel leaving the Gary plant of the Union Drawn Steel Division of the Republic Steel Corporation is slushed with oil at the time of shipment by a new system that involves the use of a mobile unit and of eleven oil-distribution stations along a railroad siding. Hundreds of gallons of light- and heavy-grade slushing oils are required for this purpose monthly, and this is stored in an underground vault in eight vertical tanks that have a capacity of 280 gallons each and are connected in batteries of four.

The portable equipment consists of a small self-contained pumping unit and air compressor and serves to apply protective coatings to material that is delivered by motor truck. The oil is carried separately in 54-gallon drums and is sprayed on to the steel with air at 32 pounds pressure after it is loaded. The supply for the stations alongside the depressed railroad track that runs into the shipping department is pumped from the tanks through 400-foot lines to two pipes that parallel the loading bay for a distance of 200 feet. Before reaching the latter point, the lines pass through a short insulated tunnel containing steam coils, and these heat the oil so that it can be maintained at a temperature of 70°F. even in zero weather. A third pipe paralleling the siding furnishes compressed air at approximately 20 pounds pressure. The several lines, as is common practice today, are painted different colors for purposes of identification: the 1½-inch air line is gray; the 1-inch pipe that delivers the heavy slushing oil is brown; and the ¾-inch line for the light oil is black.

There are two outlets at each distribution station, and these are provided with quick-coupling connectors, made up of a socket and plug, to facilitate attaching and removing the spray-gun outfit. The air and oil are delivered to the nozzle by lengths of 25-foot hose which are protected by a flexible casing and passed over a hook on the wall of the loading bay. The operator of the gun stands inside the freight car to do his work and applies the oil to the steel as fast as it is loaded.

This slushing installation is part of an extensive oil-distribution system that delivers as many as eight different petroleum products to machines and points of use throughout the Republic Steel Corporation plant. It has been found to be so satisfactory from the standpoint of economy and operation that four others are to be similarly equipped.

JEEP TAKES A RIDE

Pictured here is what is officially known as a 36-foot Navy vehicle landing boat. It is one of several types of floating craft being turned out for the armed services by the Chris-Craft Corporation of Algonac, Wis., reputed to be the world's largest builder of motorboats. Air-driven tools of various kinds enter prominently into the manufacture of the new boats.

How the "Luftwaffe" Grew

PRIOR to the beginning of the current war it seemed incredulous to many persons in this country that the Germans could possess a formidable air force, the disbelievers reasoning that the enemy had been given no chance to develop one and that it hadn't the necessary funds. Just how the *Luftwaffe* came into being is revealed in an article in *The Meccano Magazine* of London by C. G. Grey, editor of the British publication *The Aeroplane* from 1911 to 1939. The account shows that there is a direct relationship between the German air force of the last conflict and the present one, and also ventures the opinion that Germany could actually have subdued the British Isles following the Dunkerque exodus if she had not erred in building the wrong type of planes.

In the last war there was no separate German air force, its flying units, or *Fliegertruppen*, being attached to either the army or the navy. Germany had no aircraft carriers and did not learn to catapult planes from ships until after the close of hostilities. Nevertheless, in 1915 Fokker monoplanes were superior to anything the British had, and the latter's biplanes were so inadequate that they were dubbed "Fokker Fodder." As the war progressed, however, they developed better flying machines and definitely had the upper hand before the armistice, although fairness compels the admission that the German aviators were worthy foeman.

The pick of the enemy pilots was organized into groups known to the Allies as circuses. All were experts, and each group flew under a leader. The best circus was commanded by Baron Manfred von Richthofen, for whom even the British airmen had the utmost respect. Richthofen was shot down in 1918. His exploits have been widely publicized, but it is not generally known that he was succeeded as squadron leader by a young officer named Herman Goering, who is now General Goering. He commanded the circus until the war ended and proved to be a skillful and intrepid flier. When the peace terms prohibited Germany from building airplanes, many of the pilots left the country. Goering went to Sweden and became a commercial aviator. Others flew for Lithuania, Latvia, and Estonia in their fight for independence. Many of her aircraft engineers went to Russia and taught that country how to construct planes, a fact that is probably bemoaned today.

Around 1925 the ban against flying in Germany was relaxed by permitting commercial transportation. Several lines sprang up, and in after years they were merged into the Luft Hansa, or air union. Among its officers was Capt. Erhardt Milch, a pilot in World War I and today a power in German military affairs. While the Luft Hansa was being developed, gliding became a national sport with German youth, and the Sports Fliers Union had a very large membership. From gliders, the young aviators shifted to light planes of about 70 hp. There was little money available, so the members of the clubs pooled their resources to buy machines for their joint use. Gradually larger aircraft were acquired, and while they could not be considered warplanes, they served to give the pilots the training they needed to fly fighting craft. It is significant to note that during the early part of this period one of the foremost designers of soaring machines was young Willy Messerschmitt, who subsequently produced the best German fighter plane to make its appearance up to last summer.

About this time Goering and some of the other veteran pilots returned to Germany and began taking a strong interest in the flying clubs. They formed what later became openly known as the Secret Air Force and took a hand at training pilots to become fighters. In 1934 an organization that called itself the German Air Sports Club started wearing uniforms similar to those of the present *Luftwaffe* and adopted the Hitler salute. This was the beginning of the *Luftwaffe*, although it was not actually created until 1935. Goering was suddenly made a general in charge of the air force and directly responsible to Hitler, reporting through the minister of defense.

The first high-powered German airplane, a single-seater, did not appear until 1936, but *Heinkels*, *Messerschmitts*, *Henschels*, *Dornier* bombers, and other now familiar craft were seen in the skies in the years immediately following. By 1937 the *Luftwaffe* was a powerful organization, airplane production was booming, and the Germans gloried in showing their military aviation resources to visitors from other lands, the idea apparently being to impress them with this display of might. Many delegations from Great Britain went there, some of them less than a year before the outbreak of war.

The German air force probably was not so large at the outset of fighting as it was popularly supposed to be, but by then the nation was turning out planes at such a rapid rate that by the middle of 1940, when France was invaded, there must have been available a large reserve of machines. The *Luftwaffe*, perhaps influenced by the early glider experience, went in rather heavily for troop-carrying craft and towed gliders. It has since been proved that they are very vulnerable to attack by enemy fighters, and a whole string of them was shot down *en route* to Libya last May. Apparently the Germans had placed their trust in these planes, along with dive-bombers, for their proposed invasion of England. The whole strength of the *Luftwaffe's* bombers and fighters was thrown against South England to pave the way for that invasion. However, by that time the R.A.F. was ready for them and showed so much strength that no attempt was made to ferry troops across the channel in defenseless air-borne carriers. Looking back it seems that Germany, if all her air force had been in the form of fighters and bombers, might successfully have attacked the great industrial regions of England and wrought so much damage as to have crippled her production not only of planes but also of other types of fighting equipment.

Log of Our War Economy

THE following paragraphs contain significant bits of information culled from official press releases sent out by the War Production Board.

DECEMBER 22—The pulpwood supply of North America for 1943 is estimated at 20,000,000 cords, a drop of 5,000,000 cords as compared with 1942. Consequently, a 10 per cent reduction in the use of print paper is faced by all newspaper, magazine, and book publishers this year. Individual firms will be permitted to effect the economy in any way they choose. Periodicals that need less than 25 tons of paper in a quarter-year are exempt.

DECEMBER 24—Substantial savings in railway cars and motive power are being made by heavier carload freight shipments, in compliance with an order from the Office of Defense Transportation. For certain commodities the average weight of load per car showed an increase ranging from 14 to 22 per cent in November, as compared with October. If the weight is increased by 15 per cent, up to 75,000 fewer freight cars per week will be required and there will also be material economies in motive power.

To save in the production of new electric motors, manufacturers who have idle machines are being urged to make them available for sale. All types and sizes of motors are needed for the war effort. Iron, steel, aluminum, and copper—all critical metals—represent 95 per cent of the weight of a motor.

The country's hardwood consumption for 1943 has been estimated at 5,670,000,000 board feet. The greatest demand will be for boxing and crating. Civilian construction will call for the use of 800,000,000 feet. The production of hardwood will probably be 10 per less than in 1942.

DECEMBER 27—One million fireplace grates made of clay will be available for use in homes this winter. The new ceramic grates are slatted, boxlike affairs that weigh from 30 to 60 pounds each and are suitable for burning coal, wood, or charcoal. They are expected to save 30,000 tons of cast iron.

"But shouldn't we just ask him if they're his tires?"

"Notice any difference since we left the pavement, Sarge?"

DECEMBER 28—Office workers will have to get along with the stock of desk pencil sharpeners and metallic file fasteners now on hand. Further output of these articles has been stopped, along with that of repair parts for office equipment. It is expected that annual steel savings of 2,300 tons will result.

JANUARY 3—The Office of War Information has issued a pamphlet, "Inflation," to apprise people of the dangers of runaway prices and to inform them how they can forestall unbridled inflation. The wartime dilemma, it is pointed out, arises from the fact that national income far exceeds the value of goods available for civilian purchase in any one year. This naturally tends to increase prices. The country is warned that the means to be imposed upon them to stop inflation will be hard, "including taxes that dig deep into the income of people right down to the borderline of bare subsistence." It is admitted that living costs will undoubtedly rise a little more in spite of anything that can be done.

JANUARY 4—In emphasizing the importance of observing adequate safety measures in industries and homes, Paul V. McNutt, chairman of the War Manpower Commission, revealed that accidents on the home front since the country entered the war have incapacitated more men than have been killed, wounded, or captured in actual combat. Including those listed as missing, casualties in the armed forces since the Pearl Harbor attack have aggregated 58,307. During the same period casualties to American workers through on- and off-the-job accidents have numbered 46,300 dead and 4,000,000 injured.

JANUARY 16—Our war expenditures during 1942 totaled $52,406,000,000, or nearly four times those of 1941. During December, outlays were at the rate of $73,000,000,000 per year.

JANUARY 20—In his final report to Congress as retiring Price Administrator, Leon Henderson warned industry that the "honeymoon" period of expansion which has lifted profits far above normal peacetime levels has come to an end. "In the year ahead," he said, "the output of war goods will be doubled and the supplies available for civilian consumption savagely reduced. There must be a more vigorous tax program, supplemented by an unprecedented expansion of savings. There must be a broadening of the rationing program until all essential goods which are in short supply are equitably distributed."

To free equipment, materials, and other resources for more essential work, construction projects having a total cost of $1,214,850,897 have been stopped during the past twelve weeks.

JANUARY 21—Half of the "sixth" tires turned in to the Government by civilians were in such poor condition as to be appraised as scrap. This fact is interpreted by WPB to mean that there is urgent need of the system of periodical tire inspection that is now in force. Holders of "A" ration books have been given until April 1 to obtain this inspection, while all other motorists have until March 1.

"Wilbur would like to be a civilian when he grows up."

Pneumatic Clamp Makes Hard Work Easy

Raymond D. Fisher

GREAT stress is placed today on the conservation of manpower, and wherever possible industry is eliminating fatigue-inducing machine work. This is good practice, because any changeover from manual to power operation results, as a rule, also in increased production. A case in point is a 38-inch Seybold paper cutter in the printing plant of Ingersoll-Rand Company, manufacturer of compressors and a wide range of air-operated drills, tools, and equipment.

The huge machine cuts or trims anything from a single sheet of cardboard to lifts of paper or magazines approximately 6 inches high by throwing in a clutch lever by hand. This, in itself, is not hard work. However, when handling paper or pamphlets of any appreciable thickness, it is necessary that the pile be held firmly by means of a clamp so that it will not creep under the shearing action of the knife.

The clamp extends the width of the cutting table and, until several months ago, was lowered and raised by a manually operated, counterweighted foot treadle. This repetitive work was tiring because the pedal was about 12 inches above the level of the floor and had a travel of 6 inches. It meant that the operator had to stand on one foot a large share of the day and that that foot had to bear his full weight while the other one moved up and down some thousand times in the course of a shift. The result was a fatigue strain that gradually passed up through his body until, at the end of the day, even his shoulders were affected.

In order that the work might be done with less physical effort, the company's engineering department worked out a pneumatic clamping device. This consists essentially of a Schrader 4-way foot valve and of a 3-inch, double-acting Logan pneumatic cylinder with a 6-inch stroke. As the printing shop is piped for compressed air, it was a simple matter to tap the main line and to feed the air through a connection to the foot valve which, under slight pressure of the toes, admits air to the cylinder and thus actuates the clamping mechanism through a link attached to the cylinder piston. Interposed between the Schrader valve and the shop line is a Logan adjustable valve by which the line pressure of approximately 90 pounds per square inch is reduced in accordance with service needs. It is generally maintained at 60 pounds. Another adjustable valve controls the cylinder exhaust, or the speed of the piston stroke and, incidentally, that of the clamp.

The pedal of the 4-way valve is only 3 inches above the floor, or 9 inches lower than the former treadle, and as a touch of the toes causes it to respond, the operator can depress it without lifting a foot from the floor or shifting his weight. As a result of this improvement in posture he can do better work and do it faster hour in and hour out with a minimum of fatigue.

WORKS WITH EASE

The big paper cutter showing the air-operated clamping mechanism. Note how close the pedal of the 4-way valve is to the floor. Slight pressure of the toes serves to actuate the air cylinder to the left, alongside the base of the machine, and operates the clamp through a link attached to the cylinder piston. The cutter is pictured with the clamp holding down a pile of magazines ready for trimming. To bring down the knife the operator is required to throw in the clutch lever with his right hand while the left is on the safety lever. With both hands engaged there is no danger of accidents. The valve by which the line pressure is regulated is seen at the foot of the pillar at the far right.

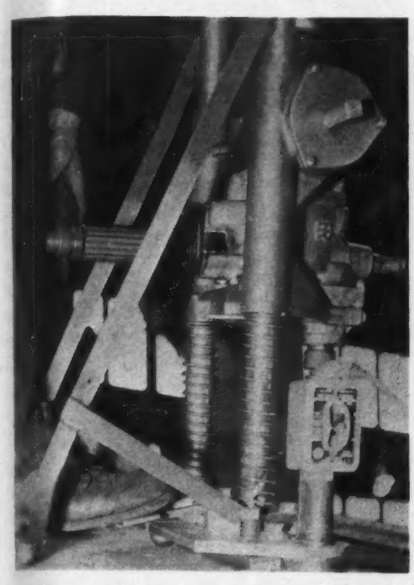
New Lumber-Drying Method

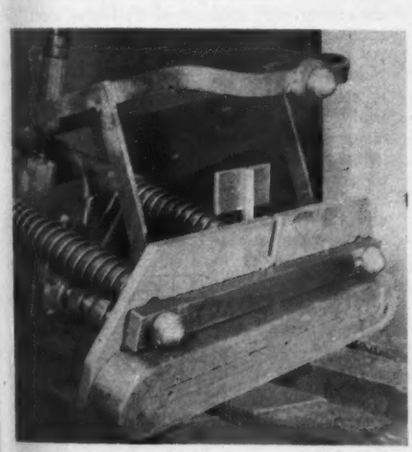
IN ATTEMPTING to prevent oil and resin in knots from bleeding and marring painted surfaces, the Western Pine Association—a research organization—would seem to have hit two birds with one stone. In addition to solving that problem, the investigators are said to have made another discovery that may prove to be of great importance to the lumber industry. They have found a process by which dripping-wet green timber can be converted into bone-dry lumber in 24 hours!

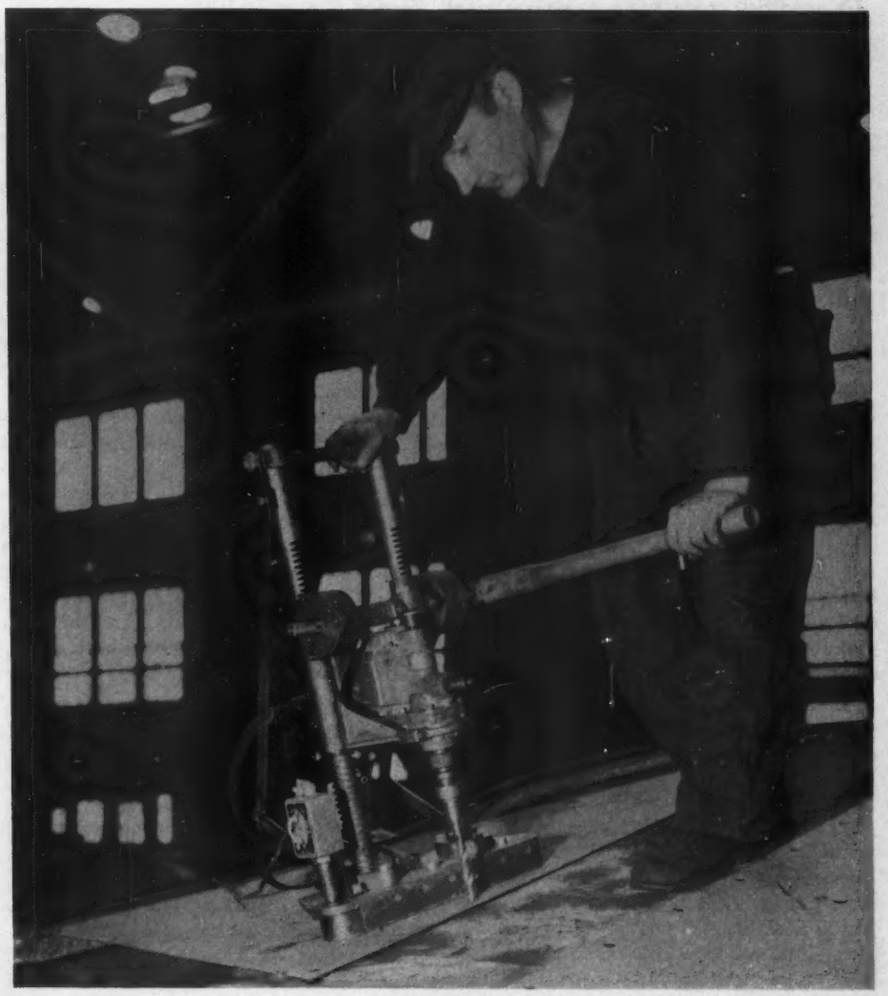
According to Dr. Arthur Anderson of the research staff of that organization, a solvent was developed after considerable experimental work that extracted enough soluble matter from a typical knot to cut down its weight by as much as 50 per cent, providing a prime painting surface. To their astonishment they found that the same solvent reduced the moisture content of typical dry lumber from 15 to 10 per cent. Tests have revealed that wood treated by the new method is much lighter in color than air- or kiln-dried lumber and that the cells are "wide open" to receive preservatives, water- or fireproofing solutions, coloring matter, etc.

The association has appropriated $15,000 for the building of a pilot extraction plant to determine the commercial possibilities of the process by which wood may be dried and impregnated in a single operation. The solvent recovered is an oily, resinous mixture that may be of value in the manufacture of paint and plastics.

Magnetic-Base Frame Holds Air Drill on Work







HELD DOWN TO WORK

The picture above shows the drill working at an angle on a large generator frame. Holes in the 1¾-inch metal section are drilled and tapped, using for templates the holes already drilled in a 3/16-inch cover plate. One man readily moves and operates the tool, and the magnetic base holds it firmly in place for accurate drilling. At the upper left, the operator's foot is on the treadle that raises the magnetic base when it is de-energized, thus permitting the assembly to be moved about on ball casters. The third picture shows details of the base and casters.

AN ELECTROMAGNETIC base having a suitable mounting for use in conjunction with a portable air tool has been developed at the Schenectady Works of the General Electric Company and has proved very satisfactory for drilling and tapping operations in the manufacture of large water-wheel generator frames and similar equipment. It also has been utilized to advantage for counterboring and for countersinking.

The outfit is relatively simple to build. It consists of a standard Ingersoll-Rand reversible Multi-Vane drill and of a rail-bonding drill frame, altered as shown in the accompanying illustrations. A third leg is added to provide stability. The drill is fitted with a taper socket and a quick-change chuck, thus permitting the operator to change quickly from a drill to a tap without disturbing the set-up. In effect, drilling and tapping are combined in one operation. The tool is fed to the work by a ratchet-and-handle arrangement.

The electromagnet used exerts a force of about 500 pounds on metal with a thickness of 3/16 inch or more. An air gap of 10 mils between the poles of the face plate and the cover plate compensates for irregularities in the cover-plate surface. The magnet operates on 120 volts and is energized and deënergized by means of a toggle switch conveniently located on the frame. A foot treadle serves to lower the magnet and to raise it for repositioning the drill. When the magnet is in the raised position, the 3-legged frame can be moved about on its ball casters.

A solenoid-operated air valve between the air source and the drill keeps the latter inoperative unless the magnet is energized. Thus, if the magnet fails to receive power, there is no chance of the tool being damaged or the operator injured. The valve is wired in parallel with the switch and on the magnet or load side, and is normally closed.

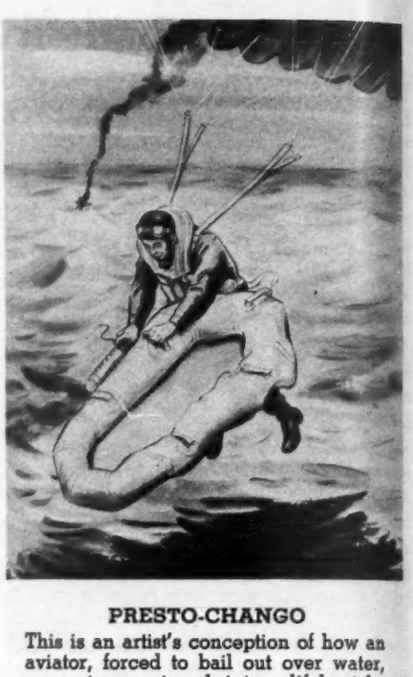
Following are the principal advantages that result from the use of the mounting: The magnetic device holds the frame firmly and evenly against the work, thus resulting in greater accuracy than if the drill were free to move about. This is true even when drilling or tapping at an angle. Furthermore, since one man can set up the equipment and perform the operation, there is a saving in manpower. There is an increase in the factor of safety because the operator does not have to hold the tool to the work. Inasmuch as the drill is provided with a taper socket and a quick-change chuck, drilling and tapping can be accomplished in almost half the time usually required. The mobility of the outfit also aids in increasing production. Being fitted with ball casters, it can be moved about easily from job to job.

New Buoyant Material Made of Strands of Bubbles

KAPOK and rubber, imported commodities, may have a serious rival for certain services in Bubblfil, an interesting new material that has come out of the laboratories of the Rayon Department of E. I. Du Pont de Nemours & Company. It is made in the form of an endless chain of bubbles each tightly sealed from its neighbors and containing compressed air. Just how the regenerated cellulose film is charged with air in the course of manufacture has not been divulged.

The new product can be used in the form of single or multiple strands, in loose masses of any dimensions, and in block form bonded with adhesives. Progress in weaving the filaments is reported. In certain respects—aging, effect of temperature, resistance to oils, etc.—Bubblfil is similar to viscose rayon, cellophane, and cellulose sponge; but, because of its "cellular" structure, it has added properties that put it in a class with sponge rubber and kapok. It is said to have an unusually low ratio of weight to bulk, exceptional buoyancy, unique characteristics as to compressibility and resilience, and heat-insulating qualities on a par with those of kapok when in bulk but higher when compacted.

While the potentialities of the material still remain to be investigated, tests have already established the fact that it is suitable for making life preservers and rafts, as well as for other military applications for which rubber and kapok are not acceptable. Packed in metal containers or in pad form it showed no evidence of shattering or scorching when exposed experimentally to the attack of 30-06 incendiary and 30 and 38 sporting bullets. At present it is produced in strands of small and medium-sized bubbles that look like strings of beads. Of the medium size, a filament 3,200 yards long weighs a pound. Hand packed, 1 cubic foot of cut strands weighs up to about 2 pounds, as against 4 pounds for machine packing. At 3.5 pounds per cubic foot, Bubblfil will support a dead weight of 48 pounds in fresh water at room temperature, or 44 pounds after 96 hours of immersion. In a 3.5 per cent salt solution, also at room temperature, it will keep 49 pounds afloat initially, 47 pounds after 48 hours of submergence, and 45 pounds after 96 hours.

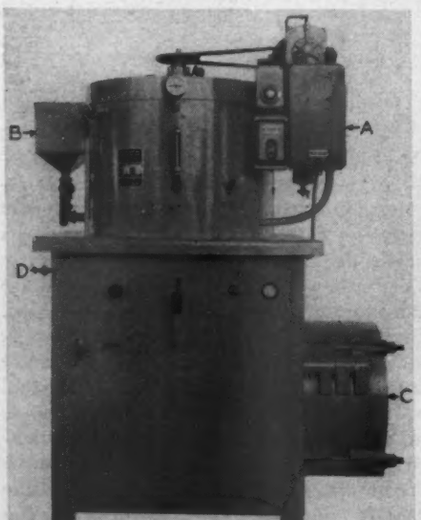


PRESTO-CHANGO

This is an artist's conception of how an aviator, forced to bail out over water, converts a seat-pack into a lifeboat by means of a 10-inch steel cylinder containing liquid carbon dioxide. The latter device was developed for the purpose by Walter Kidde & Company, and is attached to a rubberized-fabric raft that folds up, together with eleven other items of equipment, into a 17x17x5-inch bundle weighing 12 pounds. In case of emergency, the turn of a valve releases the gas, which expands to 450 times its stored volume, causing the seat-pack to turn into a 5½-foot lifeboat. The photograph has been released for publication by the Navy Department and the Office of Censorship.

Save by Reusing Industrial Oils

"OIL is ammunition—Use it wisely." In the case of lubricants this slogan might be amended by saying, "Reuse it." This requires reconditioning, of course, something that is being done widely today and making it possible to cut down on the purchases of new oil for operating engines of all kinds, air compressors, etc. Among the equipment used for this purpose is the Hilco Airline Oil Purifier, which is said to be suitable for cleaning oil of all kinds regardless of the degree of contamination or the service to which it has been put. In it the oil undergoes what is known as contact purifying—that is, it is thoroughly mixed with any suitable grade of filtering material such as fullers earth either in the raw or processed state. This is followed by heating and running the mixture through a filter press.



CLEANS USED OIL

One of the Hilco line of purifiers in which the oil is mixed with a filtering material and processed under a vacuum. It is direct-connected to one or more engines or other machines, thus obviating handling the oil. The latter is cleaned in batches, which can be measured automatically by a device interposed in the feed. A- Motor, vacuum-pump, and heater; B- hopper for filtering material; C- filter press; D- compressed-air inlet. Air is used to force the oil through the filter press.

The unit is self-contained, and the oil is cleaned in batches ranging from 6 to 130 gallons, depending upon the size of the machine. The cycle of operations is as follows: From a tank, which serves as a measure and is connected with the source of the dirty oil, a charge is drawn into a heater tank by means of a vacuum pump. Next the filtering material is added to the oil, also by suction. The mass is then heated indirectly through conduction and agitated the while for approximately one hour at an average temperature of 400°F. This is controlled by a thermostat and depends upon the oil being treated.

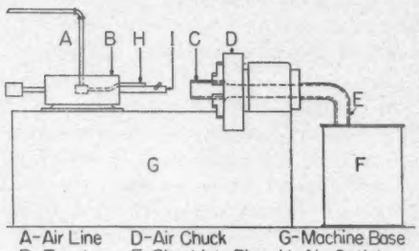
During the processing stage all solids such as tarry matter, carbon, abrasives, dust, and acids are absorbed by the filtering material, and all light ends, including water and fuel dilution, are vaporized and condensed in a distillate tank, the free air passing out by way of the vacuum exhaust. When the batch has reached the required temperature it is allowed to flow into what is called a rundown tank from which it is forced by compressed air into a filter press alongside. This is the final stage in the cycle, the filter paper retaining the solids while the oil is drawn off clean and ready for reuse. For convenience in servicing the filter press, all leaves, frames, and heads are hinged. While the charge is being forced out of the rundown tank another batch of oil and filtering material is drawn into the heater tank, thus permitting operations to go on continuously. The quantity of filtering material required depends upon the condition of the oil and the color desired. It varies from a few ounces to a pound per gallon and can be easily determined.

Processing the oil under a vacuum instead of under atmospheric pressure has numerous advantages: The working area is not contaminated with disagreeable vapors and odors; evaporation of the contained moisture and fuel dilution is effected at lower temperature and therefore with less power; and because the oil does not come in contact with air during the heating and mixing stage it is free of products of oxidation.

Lathe with Ingenious Pneumatic Chip Collector

BY THE simple expedient of blowing compressed air through passages that were formerly designed to carry cutting oil, and then carrying the opening back through a pneumatic chuck and the air cylinder that operates it, a tool designer at the Schenectady plant of the General Electric Company has provided a lathe with a chip collector that is 100 per cent efficient. The machine bores babbitt-lined, steel-shell motor bearings at relatively high speed and, until the slight change was made, scattered the chips around. Attempts were made to salvage the vital war metal from sweepings; but, with the exception of a small percentage of it, it was worthless as scrap.

Now, by connecting the oil-piping system to the shop air line, a stream of air flows through the turret, the hollow spindle of the lathe, and the bearing while boring is in progress, blowing the chips through the chuck assembly into a sheet-iron pipe that terminates in a covered barrel at the rear of the machine. The



operation is entirely automatic, as the air is turned on and off as the turret indexes. The arrangement is shown in the accompanying line drawing.

Electroplating Service

An Electroplating Division is being operated by E.I. du Pont de Nemours & Company and is at the service of plants handicapped because a machine part is slightly worn and does not function properly. A case in point is the 35-ton 6x10-foot rotor of a vertical steam turbine that developed a serious chatter because of a few thousandths of an inch of wear between the rotor and its 22-inch shaft. To do the salvage work, the rotor was dismounted and placed on timbers. To the lower face of its shaftway was attached a disk with a sponge-rubber facing. Through the disk was extended a cathode connection, and it was provided with a small petcock for the circulation of a copper-plating solution that was poured into the top of the shaftway. The necessary current was supplied by a portable motor-generator set through the medium of a cylindrical anode mounted on a cast-iron pipe so it could be moved up and down in the shaftway.

It took 28 hours to do the plating—fourteen to build up the worn area at the lower end of the shaftway and, after turning the rotor over, fourteen more to plate the corresponding area at the other end. The work was done by engineers of the Electroplating Division with the aid of equipment furnished by a local plating company.

Umbrella-Type Lightning Rods of Steel Advocated

BY THE simple expedient of raising a wire "umbrella" over a building, Dr. Gilbert D. McCann, Westinghouse Electric & Manufacturing Company engineer, shields it against lightning and does so with a minimum use of strategic war materials. The deflector was developed by him primarily as a protection for explosives plants, oil-storage centers, and other structures housing highly inflammable products, and consists simply of one or several steel wires that are strung above a building and anchored to tall wood poles, whence they are carried earthward and connected to steel rods buried in the ground.

The study of lightning strokes on power lines has revealed that each square mile of sky hurls downward annually about ten thunderbolts. This means that each of the several hundred structures that constitute a modern powder plant will be a target for lightning several times a year. Just one flash could cause a disastrous explosion or fire if proper protective devices were lacking. This can be readily understood when it is known that lightning strokes sometimes have a peak current of 200,000 amperes, or enough momentarily to supply a city of 50,000 people with electric energy. The electrical pressure may reach 20,000,000 volts, which is sufficient to blow out 200,000,000 household fuses!

The usual type of lightning rod for an explosives plant or the like requires the use of 250 pounds of copper and is attached directly to the building and grounded. It is said that the same structure could be protected by the umbrella system by means of only 60 pounds of steel and two wood poles and would easily deflect a bolt driving earthward at the rate of more than 11,000,000 miles a minute. It would also prevent lightning from leaping to metalwork and causing dangerous sparks.

UNPROTECTED

Man-made lightning, created in a surge generator which stores and then releases electricity in a single space-leaping arc, struck this model which contained gasoline. The test was made in the Westinghouse high-voltage laboratory at Trafford, Pa., and shows what may happen to a plant that is not protected against lightning.

PROTECTED

The model in this picture stands under the shelter of a simple form of steel umbrella which has warded off a stroke of lightning such as destroyed the structure at the left. The single wire is seen guiding the lightning harmlessly into the earth. Systems of this kind have already been installed by a number of war industries.

Industrial Notes

For spraying any neutral alloy with a melting point up to 600°F., Alloy Sprayer Company is offering a portable atomizer that is self-contained except for the air supply and electric power. The unit illustrated has a capacity of 12 cubic inches and is equipped with electrical elements that heat the metal in a heavily insulated pot. Temperature control throughout a range of 100° to meet the needs of individual alloys is effected by a rheostat-switch knob on the outside of the container, and a thermostat keeps the metal at any pre-set temperature. It takes approximately twelve minutes after the cord is plugged in to bring the contents up to the desired melting point. Compressed air is used to spray the molten metal and is applied by pressing a trigger on the handle of the gun. For extremely fine work the flow of air into the pot can be checked by turning a conveniently placed knob. In this way only as much metal can be sprayed as can be ejected by the available pressure. The unit is furnished complete with 15 feet of air hose and 9 feet of electric cord. It is recommended for applying protective coatings, making templates, spotting or checking dies, reproducing molds, and especially for very fine work where even pin scratches have to be faithfully reproduced.

Welding Equipment & Supply Company has announced that it is in the business of reclaiming broken or worn high-speed tools that have generally been considered unfit for further use. Teeth, flutes, tangs, shanks, and fractures in all kinds of cutting tools are repaired by what is known as Suttonizing—a welding process by which the added metal is said to become an integral part of the tool and which, in most cases, obviates the need of heat-treating the finished product. The work is done in the company's plant at 229 Leib Street, Detroit, Mich.

Concrete reinforced with wire that is tightened at the time of pouring is being made into flooring and roofing beams and slabs in Sweden. Upon release of the tension, the building material undergoes slight deflection, which is counteracted when it is subjected to its share of the full load of the structure. Size for size, the new product is said to be lighter than that made of ordinary reinforced concrete.

According to trade reports, a South African paint company is using vermiculite to give color and metallic effects to enamel applied by a recently patented process. The coating is claimed to be three times as resistant to impact as ordinary enamel.

It is reported by a London electric-power station that a minute quantity of chlorine gas in the circulating water of steam condensers prevents the growth of algae that insulates the tubes and lowers the rate of heat exchange, with its attendant loss in steaming efficiency. The gas is added to the cooling water in just the right quantity by a Chloronome and permits the turbines to run continuously, it is claimed, with an average fuel saving of 5 per cent. Prior to the treatment of the water it was the practice to shut down the turbines periodically for condenser-tube cleaning.

Rail-removal equipment, in which the rail is made to act as a lever and to assist in its own salvage, is offered by Fred W. Stiefel Associates. It consists of a pair of inverted T-beams that are placed on opposite sides and parallel to the rail, of an inverted V-shaped superstructure carrying a truck-operated block and fall that serves to lift one end of the rail, and of a transverse stripping roller that is slipped under the rail and into bearing openings in the beams. With the block and fall released, the outfit is drawn forward by the truck, pulling up the rail as it goes along. Sufficient pressure is said to be exerted against the beams by the superstructure to keep the ties in place, while the inner edges of the beams leave a narrow, clean-cut trench. It is claimed that one contractor has salvaged more than 2,000 feet of rail in an hour with this equipment. It is available on a royalty basis.

Mining Society Elects

FREDERICK W. O'NEIL, vice-president and chief engineer of Ingersoll-Rand Company, was elected president of the Mining and Metallurgical Society of America at a meeting in New York on January 12. Other officers named are Ralph B. Williams, vice-president, and Percy E. Barbour, secretary-treasurer. In accepting the office, Mr. O'Neil recommended that the society devote its full efforts to formulating a policy for aiding the mineral industry during the postwar period. The society was formed in 1908 as a strictly professional organization, with its membership limited to mining and metallurgical engineers and mining geologists.

Elektro-Purj-It is the trade name of a new noninflammable, nontoxic compound that is said to be a cleaner, disinfectant, and deodorant in one. It is offered by the Trojan Products & Manufacturing Company for the removal of dirt, soot, oil, and grease from machinery, as well as from painted surfaces, glass, wood, cement, linoleum, and other floor covering.

To avoid torsional strains in the huge alloy-steel bolts for its high-temperature, high-pressure turbines, the Westinghouse Electric & Manufacturing Company tightens them by the aid of 110-volt heaters. To make certain that they have been properly tightened and that they have been stretched just enough to assure the desired stress, the length of each bolt is measured before and after heating. The heater is inserted in a hole in the center of the cold bolt after the nut has been drawn to a snug fit. The hole also serves for taking the measurements. It requires about five minutes per inch of diameter after the current has been turned on for the bolt to become sufficiently elongated to permit turning the nut the predetermined degree. After the heater is withdrawn, the bolt is cooled quickly by a blast of compressed air to minimize flange expansion.

Spraymask is the name of a new waterproof, abrasion-resistant material for protecting plastic-glass parts such as bomber noses until the planes are ready to take off. It is a product of Adhere, Inc., and is said to be suitable for other than airplane plants for safeguarding work in process of manufacture or while in storage against paint, grease, abrasion, wind, or weather. The solution is easily applied with a regular spray gun and forms a tough film that is impervious to paint thinners and ordinary solvents. When dry it peels off neatly in sheets, as the illustration shows.